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# Conservation of the freshwater pearl mussel (*Margaritifera margaritifera*) in the river Rede, UK: Identification of instream indicators for catchment-scale issues☆

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ABSTRACT

The freshwater pearl mussel (*Margaritifera margaritifera*) is declining throughout its entire range. On the river Rede, North-East England, the population has been equally declining and shows no apparent recruitment. The study presented here aimed at characterizing water quality and habitat conditions for pearl mussels to identify possible indicators of pressures on the population and inform a restoration and conservation strategy. Water quality monitoring revealed levels of turbidity and suspended sediments to be above the limit set for functional pearl mussel rivers. Substrate sampling revealed silt was present at all sites. A loss of redox potential between the water column and the substrate occurred at all sites, indicating non suitable conditions for juvenile pearl mussels. These investigations suggest that fine sediment input in the river could be one of the factors preventing the development and survival of juvenile mussels while adults face water quality largely affected by high turbidity and high phosphate load. Restoration strategy for the Rede pearl mussel population should focus mainly on limiting sediment and nutrient input in the river throughout the catchment in order to improve habitat for juvenile pearl mussels. This work highlights the need for a catchment-based approach in order to succeed in the conservation of a fragile species.



## Introduction

The freshwater pearl mussel (*Margaritifera margaritifera*) has been declining throughout its Holarctic range as a result of pearl fishing, habitat degradation from changes in land use and river regulation, and decrease in host fish populations (Bauer 1988) and as a result is classified as an endangered species by the IUCN (Cuttelod et al. 2011). The life-cycle and water quality and substrate requirements of this freshwater bivalve are well documented (Bauer 1987; Hastie et al. 2000a,b; Hastie and Young 2003; Moorkens 2006; Geist and Auerswald 2007). Several studies have emphasized the key role of freshwater mussels, and aquatic bivalves in general, as ecosystems engineers (Gutierrez et al. 2003; Spooner and Vaughn 2006): they filter up to 50 L of water a day, thus greatly improving water quality in the immediate vicinity of mussel beds, and bed structures provide suitable within-substrate habitat for developing juveniles. As a result, freshwater pearl mussels are considered an excellent indicator of aquatic ecosystem health (Aldridge et al. 2007), and as such are an umbrella and keystone species: their conservation will benefit the entire riverine ecosystem (Vaughn and Hakenkamp 2001).

In the UK, populations of pearl mussels have equally been declining (Young 1991). The strongholds for the species are in Scotland (Cosgrove et al. 2000). In England, 10 populations remain, the second largest of which is located in the North Tyne catchment, Northumberland (north-east England). The last survey conducted on this population in 2006 identified around 27,000 freshwater pearl mussels on the rivers North Tyne and Rede (Environment Agency, unpublished data). All mussels counted were above 60 mm in size and no evidence of recruitment was found, either in the form of juvenile mussels (size less than 20 mm) or glochidial encystment on fish. It is believed that the main factor behind the historical decline in the population is pearl fishing (Perkins 2011) but that other factors have contributed to the lack of recruitment of the population, such as the decline in salmonid populations in the catchment in the early to mid-20th century (Archer 2003) and habitat and water quality degradation as a result of changes in land use (Sear 1992). However, no thorough investigation of habitat and water quality in relation to pearl mussel occurrence and decline in the catchment has ever been carried out.

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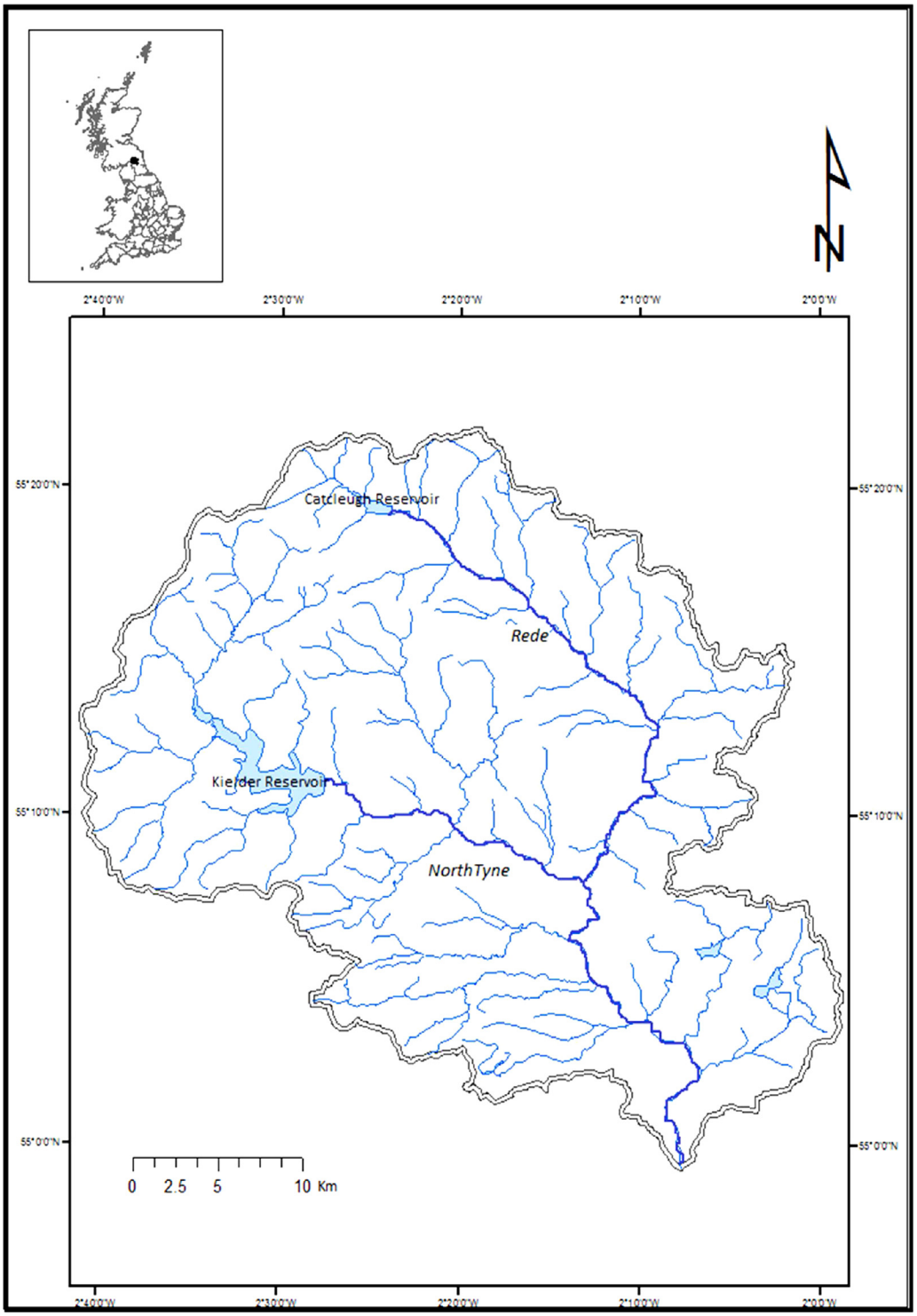


**Fig. 1.** Map of the North Tyne catchment with its location in Great Britain.

*M. margaritifera* was included in the UK Biodiversity Action Plan as a priority species in 1995 and as a result, in England, the Environment Agency has a duty to protect this species and restore its populations and habitats. Within this context, the Tyne Pearl Mussel Project was initiated in 2010, to identify the factors responsible for the decline of *M. margartifera* in the North Tyne catchment and to design a restoration plan for the population. This paper presents some of the results of the sampling carried out as part of the Tyne Pearl Mussel Project. The study presented here aimed at characterizing water quality and habitat conditions for freshwater pearl mussels in the River Rede, the main tributary to the North Tyne.

## Study site and methods

### *Study area*

The North Tyne catchment (Fig. 1) is 1118 $km^2$; it is characterized by Lower Carboniferous sandstones and limestones of the Scremerstone group (Archer and Williams 1995). Since 1982,